



# EE0003252 Driving Down HB-LED Costs

Implementation of Process Simulation Tools  
and Temperature Control Methods  
for High Yield MOCVD Growth

| Organization                                    | Team Members   | Facilities                      |
|---|--|---------------------------------|
| Veeco Process Equipment, Inc.<br>Somerset, NJ   | William Quinn, Ph.D. (Principal)<br>Veeco R&D Team<br>Veeco Advanced Hardware Team | Veeco R&D Labs                  |
| Sandia National Laboratories<br>Albuquerque, NM | Bob Biefeld, Ph.D.<br>Advanced Materials Sciences Group                            | Sandia National<br>Laboratories |
| Philips-Lumileds, Inc.<br>San Jose, CA          | Dave Vanderwater   | LED Manufacturing               |

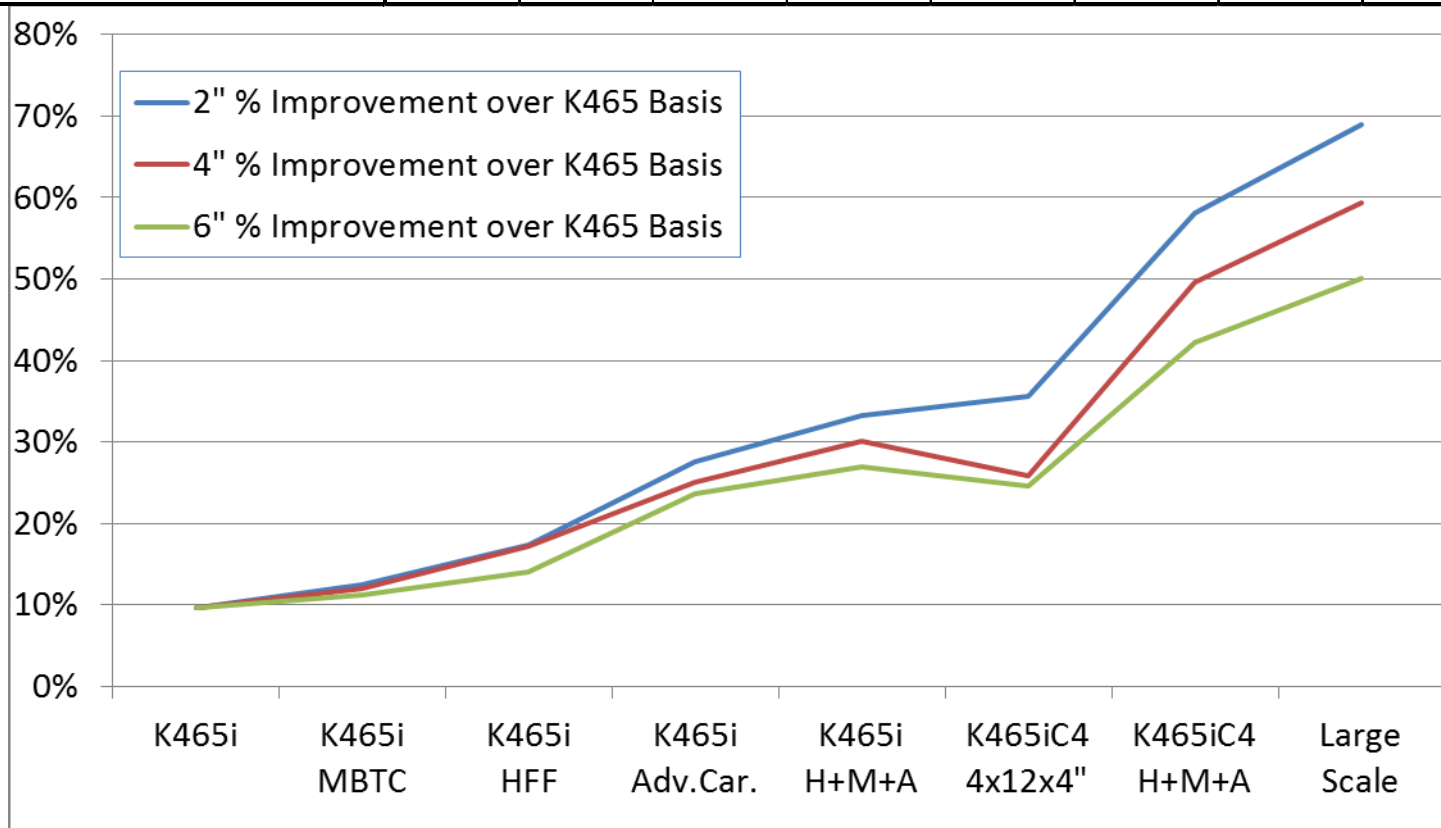
# Program Summary

- Goal: 75% (4x) cost reduction in the epitaxy phase of HB-LED manufacture
- Structure:
  - Phase I      Enabling Technology:      Predictive chemistry models & Pyrometry
  - Phase II      Continuous Improvement:      Process control, Operations & Yield
  - Phase III      Next-Generation Products:      Clusters, Efficiency & Large-scale Architecture
- Results
  - Feasibility to 70% CoO reduction
  - 5 Full-time equivalent federally-funded R&D jobs
  - 3 items now generate revenue
  - 2 items are in customer beta evaluations
  - 3 items continue to be funded

|                 | Start Date | End Date | DOE Share   | Veeco Share  | National Lab Share | Total        |
|-----------------|------------|----------|-------------|--------------|--------------------|--------------|
| Budget Period 1 | 05/01/10   | 04/30/11 | \$1,238,501 | \$5,839,030  | \$761,499          | \$7,839,030  |
| Budget Period 2 | 05/01/11   | 04/30/12 | \$1,161,499 | \$6,668,725  | \$838,501          | \$8,668,725  |
| Total           | 05/01/10   | 04/30/12 | \$2,400,000 | \$12,507,755 | \$1,600,000        | \$16,507,755 |

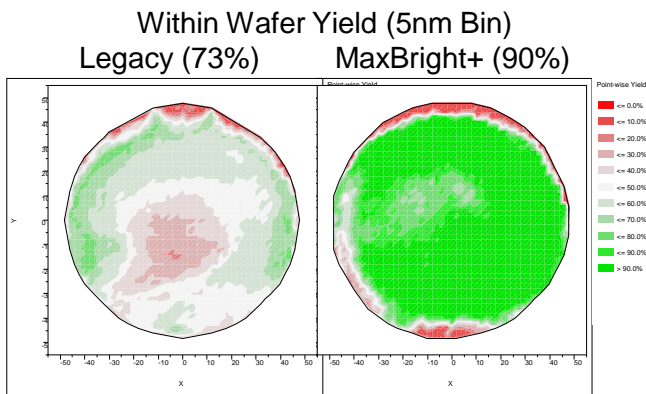
# Cost of Ownership by Wafer Size

| System Configuration             | K465i | K465i MBTC | K465i HFF | K465i Adv.Car. | K465i H+M+A | K465iC4 4x12x4" | K465iC4 H+M+A | Large Scale |
|----------------------------------|-------|------------|-----------|----------------|-------------|-----------------|---------------|-------------|
| 2" % Improvement over K465 Basis | 10%   | 13%        | 17%       | 28%            | 33%         | 36%             | 58%           | 69%         |
| 4" % Improvement over K465 Basis | 10%   | 12%        | 17%       | 25%            | 30%         | 26%             | 50%           | 59%         |
| 6" % Improvement over K465 Basis | 10%   | 11%        | 14%       | 24%            | 27%         | 25%             | 42%           | 50%         |



# Program Impact

- Accelerating the MOCVD/LED industry in the U.S.
- Veeco growth
  - Leading equipment supplier for large, high-growth LED & Solar Markets
  - Market-share leader through Q1-12
  - Market share increased from 42% to 51% over major competition
- U.S. Impacts
  - >95% of tools exported



Source: Credit Suisse 3/2/2012

